
(12) **UK Patent Application** (19) **GB** (11) **2 095 558 A**

(21) Application No **8209214**

(22) Date of filing

29 Mar 1982

(30) Priority data

(31) **8109876**

(32) **30 Mar 1981**

(33) **United Kingdom (GB)**

(43) Application published

6 Oct 1982

(51) **INT CL³ A01N 25/34**

(52) Domestic classification

A5E 405 406 411 500

503 504 506 507 J

C1B 3DX 3G 4

(56) Documents cited

GB 1590574

GB 1590573

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GB 1364902

GB 1237018

GB 0425974

(58) Field of search

A5E

C1B

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(54) **Formulation of agricultural chemicals**

(57) A water soluble film containing a pre-determined amount of an agricultural chemical is described. The film is dissolved in a specified volume of water to produce a solution or dispersion for application.

The method is particularly suitable for accurately preparing small volumes of solutions.

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SPECIFICATION

Formulation of agricultural chemicals

- 5 This invention concerns a method of formulating agricultural chemicals and is mainly but not exclusively concerned with the presentation of small quantities of such chemicals in a form suitable for small scale use. 5

Agricultural chemicals for small scale use, for example by the home gardener, are usually sold in the form of concentrated liquids for dilution prior to application or as powders which are dissolved or dispersed in water prior to use. Whilst these products are widely used, it can be difficult, inconvenient or potentially hazardous to measure out the small quantities of material required, and liquids in particular can be difficult to pack, handle and store. 10

We have found that these difficulties can be overcome by incorporating an appropriate amount of the chemical in a piece of water soluble film for dissolution or dispersion in a specified amount of water. This method makes it very easy for the user to prepare a solution of the correct concentration, without waste or spillage. The film is moreover a lightweight material which is easier to pack and store than is the case with powders and liquids. Although the method is particularly suitable for preparing relatively small volumes of solutions, it is also applicable to the preparation of large volumes for commercial or farm use. 15

20 The invention thus provides a water soluble film in which is uniformly incorporated a predetermined amount of one or more agricultural chemicals, the amount being such that when the film is dissolved in at least 100 times its weight of water a solution or dispersion of the chemical or chemicals is given of appropriate concentration for application. 20

The invention also provides a pack comprising a plurality of pieces of film as just defined or a strip of such film which can be sub-divided into such pieces, together with instructions for their dilution with a specified amount of water to prepare a solution of appropriate concentration for application. These instructions may be printed on the pack or provided on a separate leaflet or pamphlet, or may even be printed on the film itself. 25

The invention further provides a method of applying an agricultural chemical to a plant or the ground which includes the step of preparing a solution or dispersion of the chemical of appropriate concentration for application by dissolving a piece of film as defined above in water. The solutions or dispersions prepared in this way may of course be applied to plants or crops in the normal way, i.e. by watering, spraying or irrigation. 30

The chemical which is included in the film may for example be an insecticide, fungicide, herbicide, bactericide or other pesticide, or a fertiliser, micro-nutrient, growth regulator, trace element or chelate and mixtures of such materials may be used if desired. Conventional additives such as a surfactant, dispersant, emulsifier, wetting agent, dyes, pigment or adhesive may also be included. 35

For small scale use the film may be cut into pieces of convenient size and shape, e.g. squares or rectangles having an area of 4 cm² or more, e.g. up to 1 m². Alternatively, the film may be sold in the form of a strip from which such pieces can be cut or torn off. The strip can be provided with perforations or other lines of weakness for this purpose. 40

Correspondingly larger pieces may be used for commercial application.

The film may be of any convenient thickness, e.g. 0.3–1.0 mm.

45 The concentration of the active ingredient may vary from 5 up to 55% by weight, depending on potency of the chemicals and the loading capacity of the film material. 45

The amount of the chemical incorporated in the film will of course depend on the particular chemical concerned, but for small scale use it is generally convenient to include sufficient for each piece of film to provide after dilution with water from half a pint (285 mls) to a gallon (4.5 litres) (alternatively, 0.25–5 litres) of solution of appropriate strength for application. Most agricultural chemicals used by the home gardener are applied at very low concentrations and thus the volume of water used for dilution of the pieces of film is relatively large as compared to the amount of chemical. The amount of water for dilution is thus at least 100 or 200 and usually 1000 or more times the weight of the film, although again the exact figure will depend on the particular chemical concerned. 50 55

The water soluble film used may be of any suitable film-forming material, for example polyvinyl alcohol, methyl cellulose or similar materials.

To enable the film to be handled without the user touching the active ingredients, the film may be produced such that there is an area which does not contain any active ingredient. This area is conveniently at an edge or corner of the piece of film, and is preferably in the form of a strip along one edge of the film. The area may be coloured for identification. 60

The film incorporating the chemical may be produced by any suitable technique for manufacturing water soluble film. For example, the chemical or chemicals and any other additive may first be mixed with the film-forming material and the mixture then heated and stirred to ensure uniform distribution. The mixture can then be extruded onto a continuous 65 65

moving belt to form a continuous strip of film, with the belt speed and/or extruder being adjusted as necessary to give the required thickness. The belt may be embossed to facilitate separation of the film, which is dried while on the belt. When dry, the film can be wound onto a drum to form a continuous roll, from which pieces or strips of the desired size can be cut.

- 5 Film having an area not containing active ingredients may be produced in the same general manner, for example by extruding a film containing one or more strips which do not contain the active chemicals. The film may then be cut into individual pieces each having an edge strip where the material can be handled without contact with the active ingredients. A divided extruder may be used for this purpose, in which film-forming mixtures with and without active ingredients can be separately fed to different parts of the extrusion die; the two mixtures can then be co-extruded to form a continuous sheet. For example the extruder reservoir may be equipped with dividers near each end to provide separate compartments at the ends for film-forming material which does not include active ingredients and another compartment (which may be sub-divided) between the end compartments, for the material which does contain active ingredients. Film produced from such an extruder thus has a strip along each edge which is free of active ingredients. A dye may be included in the film-forming mixture which does not contain active ingredients, to identify the handling strips.

- 15 The film may be packed in any convenient manner, for example in cartons or bags, together with instructions regarding the amount of water to be used to dilute each piece of film and, if desired, other information concerning the application of the solution.

20 The following examples illustrate the invention.

EXAMPLES 1-3

- 25 Films approximately 15×10^{-3} inches (0.38 mm) thick were cast from each of the following compositions:

Example 1 Broad Spectrum Fungicide

- | | | | |
|----|-----------------------|-------------|----|
| 30 | Polyvinyl alcohol | 7.45 kg. | |
| | Glycerin BP | 0.80 kg. | |
| | Water | 20 litres. | 30 |
| | Carbendazim Technical | 3.37 kg. | |
| | Wetting Agent | as required | |
- (Carbendazim is methyl benzimidazol-2-yl carbamate)

- 35

Example 2 Insecticide

- | | | | |
|----|-------------------|-------------|----|
| 40 | Polyvinyl alcohol | 7.45 kg. | |
| | Glycerin BP | 0.80 kg. | |
| | Water | 20 litres | |
| | Lindane Technical | 1.68 kg. | 40 |
| | Wetting Agent | as required | |
- (Lindane is high purity gamma-1,2,3,4,5,6-hexachlorocyclohexane)

- 45

Example 3 Insecticide

- | | | | |
|----|--------------------|--------------|----|
| 50 | Polyvinyl alcohol | 7.45 kg. | |
| | Glycerin BP | 0.80 kg. | |
| | Water | 20 litres | |
| | Carbaryl Technical | 10.00 kg. | |
| | Wetting Agent | as required. | 50 |
- (Carbaryl is 1-naphthyl-N-methylcarbamate)

- 55 After casting the material was cut into squares 50 mm \times 50 mm, weighing approximately 275 mg. The squares were placed in packets with directions for their use by dissolving each sheet in $\frac{1}{2}$ pint (285 mls) water, for example by leaving the material in water for 30 seconds and then stirring. The solution can then be applied as a medium to fine spray.

The packets may also contain more specific directions for particular uses. For example, film made from the composition of Example 2 can be packed with the following instructions:

- 60 **LINDANE GARDEN INSECTICIDE.**

Put measured amount of water into the sprayer. Add indicated number of sheets of Lindane Film for each pint of water. Allow to stand for one minute and then agitate until the film has dissolved and dispersed. Spray the leaves of the crop or plants to run off.

	PEST	SHEETS PER PINT OF WATER.	
5	Apples, Pears, Plums	Aphids	3
		Capsid	2
		Sawfly	2
	Roses	Aphids	3
	Brassicæ	Flea Beetle	2
	<i>Green House Crops</i>		
10	Tomatoes	Aphids	2
	Flower Crops	Aphids	2
		Leaf Miner	2
		Thrips	2
		Gall Midge	4
15	The same method and film-forming mixture as described in Examples 1-3 may be used for other active ingredients, for example insecticides such as Heptenophos and Permethrin.		

CLAIMS

- 20 1. A water soluble film in which is uniformly incorporated a predetermined amount of one or more agricultural chemicals, the amount being such that when the film is dissolved in at least 100 times its weight of water a solution or dispersion of the chemical or chemicals is given of appropriate concentration for application.
- 25 2. A film as claimed in claim 1 in which the agricultural chemical is an insecticide, fungicide, herbicide, fertiliser, micronutrient or growth regulator.
- 30 3. A film as claimed in claim 1 or claim 2 in the form of a piece which contains sufficient of the agricultural chemical to provide after dilution with water from 0.25-5 litres of solution of appropriate strength for application.
- 35 4. A film as claimed in any one of the preceding claims in which there is an area which does not contain said agricultural chemicals, so that the film may be handled without contact with those chemicals.
- 40 5. A film as claimed in claim 4 in which said area is a strip along one edge of the film.
- 45 6. A film as claimed in claim 4 or 5 in which said area is coloured for identification.
7. A film as claimed in any one of the preceding claims wherein the film-forming material is polyvinyl alcohol or methyl cellulose.
8. A film as claimed in claim 1, substantially as described herein in any one of the Examples.
9. A pack comprising a plurality of pieces of film as defined in any one of the preceding claims, together with instructions for their dilution with a specified amount of water to prepare a solution of appropriate strength for application.
10. A method of applying an agricultural chemical to a plant or the ground which includes the step of preparing a solution or dispersion of the chemical of appropriate concentration for application by dissolving a piece of film as defined in any one of claims 1 to 8 in water.
11. A method of preparing a film as claimed in any one of claims 1 to 7 which comprises extruding a film-forming material containing said agricultural chemical(s) into a continuous strip.
12. A method as claimed in claim 11 in which film-forming mixtures (a) containing and (b) not containing the said agricultural chemical(s) are co-extruded from separate compartments of a divided extruder to produce a film comprising at least one handling strip which does not contain said chemical(s).